

REVIEW

The quality of meat and the very idea of slaughter: how to reconcile what seems irreconcilable

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Abstract

More than a century after Upton Sinclair's *The Jungle*, slaughterhouses continue to occupy a difficult symbolic place in public debate, even though the technological, hygienic, and regulatory frameworks governing modern meat production have changed profoundly. Contemporary slaughterhouses are highly organized industrial environments in which animal welfare, food safety, operator training, and traceability are addressed through codified procedures and official controls. At the same time, slaughter remains ethically contentious because it lies at the intersection of human nutrition, animal welfare, religious freedom, and consumer autonomy. This paper discusses how the concept of meat quality has expanded beyond physicochemical and hygienic attributes to include social, ethical, and informational dimensions, particularly in relation to slaughter methods and consumer expectations. Special attention is given to ritual slaughter in Europe and Italy, where slaughter without prior stunning remains legally possible under specific derogations for religious rites, while public concern persists regarding welfare implications and the marketing of meat from such animals in the conventional market. Slaughterhouse data are also considered as an epidemiological and welfare observatory, capable of providing information on carcass lesions, condemnations, contamination pathways, antimicrobial resistance, and zoonotic risks that are relevant to both veterinary public health and food business management. Reconciling the apparent contradiction between slaughter and welfare requires not rhetorical simplification but a rigorous, evidence-based framework in which welfare indicators, process hygiene, traceability, and transparent information coexist with cultural and religious pluralism.

Keywords: Meat quality; slaughterhouse; animal welfare; ritual slaughter; labelling; meat inspection; food safety; traceability

Introduction

More than a hundred years after the publication of Upton Sinclair's *The Jungle*, a portion of consumers still retain an imprecise and emotionally charged representation of what happens in slaughterhouses. That perception is understandable, because slaughter is one of the few food production activities in which the ethical, symbolic, and material dimensions of the food chain become inseparable.

Yet the slaughterhouse of today is not the slaughterhouse described in early twentieth-century investigative literature. Contemporary plants operate within a dense network of structural requirements, hygiene rules, official controls, and increasingly sophisticated monitoring systems designed to protect public health, animal welfare, and product quality (García-Díez et al., 2023; Marcello Trevisani et al., 2024b).

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This transformation does not eliminate the conceptual tension between the principle of animal welfare and the act of slaughter itself. Rather, it shifts the discussion from a simple moral opposition toward a more complex question: under what conditions can slaughter be regulated, monitored, and communicated in ways that minimize suffering, protect consumers, and preserve legitimate cultural and religious practices (Anonymous, 2016; D'Amico et al., 2017)? In this perspective, meat quality can no longer be understood only as tenderness, colour, pH, water-holding capacity, or absence of microbiological hazards. It also includes what may be called social and ethical quality: the degree to which the food system is perceived as transparent, welfare-conscious, and respectful of consumer values (Cenci-Goga et al., 2024; García-Díez et al., 2023; Trevisani et al., 2024b).

European legislation has progressively strengthened this broader approach. Official controls and hygiene law place responsibility on food business operators and competent authorities to ensure that food of animal origin is produced under conditions that protect human health, while more recent risk-based approaches to meat safety emphasize the use of data, surveillance, and corrective actions rather than reliance on traditional visual inspection alone (Cenci-Goga et al., 2024; García-Díez et al., 2023; Trevisani et al., 2024b). This evolution is especially relevant in the slaughterhouse, which increasingly functions not only as a point of carcass examination but also as an observatory for epidemiological trends, welfare failures, process hygiene weaknesses, and emerging microbiological hazards (García-Díez et al., 2023; Guardone et al., 2020; Trevisani et al., 2024b).

Within this broader framework, ritual slaughter remains one of the most debated issues. In the European Union, slaughter without stunning is generally prohibited but may be permitted, under derogation, for religious rites carried out in licensed slaughterhouses (D'Amico et al., 2017). This legal compromise attempts to balance animal welfare with freedom of religion, but it leaves unresolved several practical and ethical questions regarding the welfare impact of non-stun slaughter, the fate of non-certified cuts entering the conventional market, and the right of consumers to receive meaningful information on slaughter methods (D'Amico et al., 2017). The Italian case is particularly useful because it illustrates both the limited quantitative relevance

of ritual slaughter in national terms and the disproportionate importance of the debate it generates in relation to welfare, identity, and labelling (D'Amico et al., 2017).

This perspective paper combines literature-based reflection with an interpretive discussion of animal welfare, meat quality, slaughterhouse practice, and consumer information.

Meat quality beyond the carcass

The traditional language of meat science has long focused on measurable product attributes. These include hygienic status, technological suitability, sensory performance, shelf life, and compositional characteristics (Warner et al., 2017). However, the current evolution of food systems makes it increasingly clear that meat quality is also relational: it depends on how production practices are organized, how risks are managed, and how information is transmitted to actors along the chain and to final consumers (Font-i-Furnols & Guerrero, 2014; Marcello Trevisani et al., 2024b). This broader interpretation is consistent with the growing emphasis on food safety culture, traceability, and risk communication. A modern meat chain is expected not only to produce a safe and commercially valuable product, but also to demonstrate procedural control over the biological and ethical risks associated with production (Cenci-Goga et al., 2024; De Boer et al., 2014; Trevisani et al., 2024b; Troy & Kerry, 2010). The slaughterhouse occupies a central position in this architecture because it is the place where animal health, animal welfare, meat inspection, contamination control, and official verification converge. For this reason, meat quality should be understood as the outcome of an integrated system. Welfare during transport and handling affects bruising, stress, carcass defects, and occasionally the microbiological status of meat (García-Díez et al., 2023). Farm-level health management influences the prevalence of lesions observed at post-mortem inspection and the occurrence of condemnations (Cenci-Goga et al., 2024; Guardone et al., 2020). Process design within the slaughterhouse influences cross-contamination, hygienic performance, and the interpretability of surveillance data (García-Díez et al., 2023; Trevisani et al., 2024b). Seen in this way, quality is not a static attribute of meat but the visible expression of how effectively an entire chain has governed risk and responsibility.

The slaughterhouse as observatory

Recent literature strongly supports the view that slaughterhouses are epidemiological observatories rather than merely terminal inspection points. Reviews of slaughterhouse-based surveillance show that data collected during ante-mortem and post-mortem inspection can reveal information on welfare conditions, endemic disease, zoonotic risk, antimicrobial resistance, and process failures relevant to both primary production and public health (Cenci-Goga et al., 2024; García-Díez et al., 2023). The slaughterhouse therefore acts as a place where invisible conditions from the farm and transport stages become materially legible through lesions, bruises, condemnations, microbial findings, and non-compliances. Examples are abundant. Carcass bruising in cattle has been associated with handling, loading, unloading, transport conditions, and poor welfare during the pre-slaughter phase (Campagnolo et al., 2024; García-Díez et al., 2023). In pigs and other species, condemnation data and organ lesions have been used to identify recurring pathological and management problems and to support risk-based surveillance systems (García-Díez et al., 2023; Guardone et al., 2020). In central Italy, retrospective analyses of slaughterhouse activity have shown how seizure and destruction data can be interpreted not simply as administrative outcomes but as indicators of health, welfare, and chain performance (Ceccarelli et al., 2018; Cenci-Goga et al., 2024; Guardone et al., 2020). The same logic applies to microbiological safety. The detection of *Escherichia coli* in bovine lymph nodes demonstrates that contamination risk cannot be reduced to superficial carcass soiling alone, because deeper anatomical reservoirs may also contribute to public health risk (Cenci-Goga et al., 2024; Grispoldi et al., 2020). More broadly, recent discussions on risk-based meat safety assurance systems stress that slaughterhouse management should systematically collect, integrate, and act upon information about contamination hazards, flock or herd health, process hygiene, and evidence of ineffective corrective actions (Trevisani et al., 2024b). In this sense, the slaughterhouse is where data become decisions.

Ritual slaughter and its contradictions

The European legal framework recognizes a general requirement for stunning before slaughter, while also allowing derogations for religious slaughter carried out in approved slaughterhouses

(D'Amico et al., 2017; Farouk et al., 2014). This compromise reflects the coexistence of distinct normative values: the protection of animals at the time of killing, the freedom to practice religion, and the circulation of food within a pluralistic market. However, the compromise becomes unstable when welfare concerns, market practices, and consumer expectations collide (Novelli et al., 2016; Rossi et al., 2013; Salamano & Cenci Goga, 2015; Velarde et al., 2014). The evidence summarized in the Italian case study by D'Amico et al. (2017) is particularly instructive. In a Tuscan slaughterhouse during 2016, 656 cattle were slaughtered without stunning, of which 538 were processed according to *dhabiha* and 118 according to *shechita*. All carcasses slaughtered according to the Islamic procedure were accepted as halal, whereas 77.1% of carcasses slaughtered according to the Jewish procedure were rejected from kosher certification. Rejection occurred half after thoracic cavity inspection and half after examination of lungs and liver, and all rejected carcasses, together with hindquarters not subjected to *nikkur*, entered the conventional non-religious market.

These findings make visible a structural contradiction. From the point of view of the religious market, rejection is part of a coherent system of classification based on ritual and anatomical criteria. From the point of view of the general market, however, the same meat may circulate without any information indicating that the animals were slaughtered without stunning (European Food Safety Authority, 2026; Janiszewski et al., 2025; Novelli et al., 2016; Papadopoulos, 2025). The issue is not only commercial but epistemic: consumers who consider welfare relevant to their purchasing decisions may be unable to exercise informed choice when such information is absent (De Jonge & van Trijp, 2013; Fuseini et al., 2016; Gori et al., 2017; Lada et al., 2009; Lever & Miele, 2012).

The contrast between *shechita* and *dhabiha* also illustrates the danger of treating ritual slaughter as a single undifferentiated category. In the Tuscan study, Jewish slaughter was associated with a far stricter post-mortem selection process and a much higher proportion of rejected carcasses than Islamic slaughter. The literature cited in that study also notes technical and doctrinal differences concerning the operator, the knife, the inspection of organs, and the acceptability of reversible stunning among some Muslim communities. Consequently, any serious discussion of ritual slaughter must distinguish

between legal categories, religious doctrines, practical slaughterhouse procedures, and the downstream commercial use of the resulting meat (D'Amico et al., 2017).

Welfare implications

The welfare implications of non-stun slaughter remain central to the debate. Several studies emphasize that cattle present particular physiological challenges because the anatomy of their cerebral circulation and the possibility of false aneurysm formation may prolong consciousness after neck cutting (Cenci-Goga et al., 2010; Novelli et al., 2016; Rossi et al., 2013; Salamano & Cenci Goga, 2015; Velarde et al., 2014). Some interesting conclusions have been provided by the Borest project (Anonymous, 2016) which is the report on systems restraining bovine animals by inversion or any unnatural position indicated in regulation 1099/2009 at article 27, point 2: *"No later than 8 December 2012, the Commission shall submit to the European Parliament and to the Council a report on systems restraining bovine animals by inversion or any unnatural position. This report shall be based on the results of a scientific study comparing these systems to the ones maintaining bovines in the upright position and shall take into account animal welfare aspects as well as the socio-economic implications, including their acceptability by the religious communities and the safety of operators. This report shall, if appropriate, be accompanied by legislative proposals with a view to amending this Regulation concerning the systems restraining bovine animals by inversion or any unnatural position."* The report confirms that this critical window of sensibility in cattle is long and highly variable, with reported times to insensibility after ventral neck incision ranging from a few seconds to several minutes, and no consistent advantage of rotating over upright restraint systems with respect to time to loss of consciousness. What emerges instead is that welfare outcomes are driven more by the quality and duration of restraint, the design of the head fixation, and the skill of the operator than by the mere choice of restraining the animal in lateral, dorsal, or upright position. From a practical point of view, this means that restraining devices should be designed to minimise the duration of immobilisation before cutting, avoid hyperextension of the neck and excessive pressure on body surfaces, and guarantee the possibility of an immediate post cut stun when bleeding is delayed or ineffective, regardless of the pen

type adopted (Anonymous, 2016). This concern is not purely theoretical: the cited literature describes how severed carotid arteries may become partially occluded, slowing exsanguination and delaying loss of consciousness (Velarde et al., 2014). Such mechanisms explain why cattle occupy a particularly sensitive place in discussions about slaughter without prior stunning (European Food Safety Authority, 2026; Gori et al., 2017; Grandin, 2013; Janiszewski et al., 2025; Rossi et al., 2013).

Several studies, on the other hand, suggest that the restraint method also matters. European analyses have favoured upright restraint over inversion, because inversion is associated with greater stress and discomfort, even though upright positioning may make cutting more difficult for the operator (Directorate-General for & Food, 2015; Poeta et al., 2013; Velarde et al., 2014). In the Tuscan study, both Jewish and Muslim operators performed slaughter in the upright position and did not use the available rotating pen, a finding consistent with earlier observations in Italy (Cenci-Goga, 2020; Novelli et al., 2016). This is important because welfare during slaughter is not determined only by the presence or absence of stunning but also by restraint, operator skill, knife quality, animal handling, and the speed and completeness of bleeding (D'Amico et al., 2017; Directorate-General for & Food, 2015; European Food Safety Authority, 2026; Velarde et al., 2014). A broader slaughterhouse perspective reinforces this point. Reviews of welfare surveillance show that bruises, hoof disorders, lesions, and other post-mortem findings can serve as indicators of cumulative welfare problems occurring at farm, transport, and slaughterhouse levels (García-Díez et al., 2023). Thus, a consistent welfare policy should avoid isolating ritual slaughter from the rest of the slaughter process and should instead evaluate the entire sequence of events that may generate pain, fear, distress, and injury (Campagnolo et al., 2024; European Food Safety Authority, 2026; Health & Welfare, 2020; Janiszewski et al., 2025; Qekwana et al., 2017).

Information, labelling and consumer autonomy

The question of labelling arises from the mismatch between process characteristics and consumer knowledge. D'Amico et al. (2017) report that meat from animals slaughtered without stunning, especially carcasses rejected from kosher certification, may be sold in conventional channels without specific information to consumers.

The same paper discusses a European Commission consumer study in which a substantial proportion of respondents expressed interest in information on the stunning of animals, although that interest did not necessarily emerge spontaneously when consumers were not directly prompted (D'Amico et al., 2017; European Food Safety Authority, 2026; Gori et al., 2017; Papadopoulos, 2025). This ambiguity is revealing. On one hand, it suggests that stunning method is not yet a routine purchasing criterion for most consumers. On the other, it indicates that many people consider the information relevant once the issue is made explicit. The challenge is therefore not only whether to label but how to label. According to the position discussed in the literature, labelling focused on whether animals were stunned or not may be more appropriate than labels naming religious categories, because it informs consumers without directly stigmatizing Jewish or Muslim communities (De Jonge & van Trijp, 2013; Directorate-General for & Food, 2015; Lada et al., 2009; Lever & Miele, 2012).

A rigid textual label may nevertheless produce simplification or alarm if consumers lack background knowledge of slaughter practices. For this reason, the suggestion of communicating welfare-relevant information through neutral coding systems deserves consideration, provided such systems are not obscure or inaccessible (D'Amico et al., 2017; De Jonge & van Trijp, 2013; Directorate-General for & Food, 2015; Lada et al., 2009; Lever & Miele, 2012). More generally, information policy should be linked to education. Transparency without interpretive support risks polarizing public discourse rather than improving informed choice.

From traditional inspection to risk-based assurance

A second major development concerns the move from conventional meat inspection toward risk-based meat safety assurance (RB-MSAS). Recent literature on RB-MSAS argues that traditional inspection systems were designed mainly to detect gross lesions associated with hazards that have declined in prevalence, whereas current food safety risks increasingly concern pathogens and contamination processes that are not reliably detected by visual post-mortem examination alone (Campagnolo et al., 2024; European Food Safety Authority, 2026; Farouk et al., 2014; Garcia-Diez et al., 2023; Qekwana et al., 2017; Trevisani et al., 2024b). This does not make classical inspection obsolete, but it changes

its function. In risk-based systems, surveillance data, process hygiene criteria, harmonised epidemiological indicators, and evidence-based corrective actions become central (Trevisani et al., 2024b). The slaughterhouse must monitor not only visible abnormalities but also the frequency and severity of contamination events, the reliability of food chain information, and the effectiveness of preventive measures. Public veterinary officers play an essential role in this framework by verifying compliance, evaluating management systems, and imposing corrective action when food business operators fail to regain control of the process (Trevisani et al., 2024b). This approach is highly relevant to the present topic because many of the controversies around slaughter concern not only ethics but also information asymmetry and risk governance. A slaughterhouse that functions as a risk-based observatory can provide better evidence on contamination pathways, welfare indicators, and market destinations of carcasses or cuts (García-Díez et al., 2023; Trevisani et al., 2024b). Such evidence is indispensable if discussions on ritual slaughter, consumer information, and product quality are to move beyond ideology.

Microbiological safety and hidden reservoirs

Any serious discussion of slaughter quality must also include microbiological risk. Several of studies highlight that contamination at slaughter can derive from multiple reservoirs and transmission routes, some visible and some not (Cenci-Goga et al., 2024; García-Díez et al., 2023; Grispoldi et al., 2020; Papoula-Pereira et al., 2025). The study on bovine lymph nodes as a source of *E. coli* contamination is especially important in this regard because it shows that hygienic control cannot focus solely on external carcass surfaces (Cenci-Goga et al., 2024; Grispoldi et al., 2020). Deep tissues, lymphatic structures, and process-related dissemination may all contribute to contamination events. More generally, the literature on slaughterhouse surveillance shows that slaughter environments are important points for monitoring antimicrobial resistance and zoonotic agents (Cenci-Goga et al., 2013; Cenci-Goga et al., 2024; Garcia-Diez et al., 2023; García-Díez et al., 2023). Surveillance should include carcasses, surfaces, and equipment, since resistant bacteria and antimicrobial resistance genes may circulate through the slaughter environment and spread onto meat (García-Díez et al., 2023). These considerations stren-

gthen the argument that meat quality is inseparable from process control and data integration. The Salmonella scoping review by Papoula-Pereira et al. (2025) adds an economic and systems-level dimension. It emphasizes that food safety interventions must be assessed not only for microbiological efficacy but also for where costs and benefits fall along the chain, since private operators often bear the costs while public health systems capture much of the benefit (Papoula-Pereira et al., 2025). This observation is relevant for slaughter policy as well: transparency, improved monitoring, and welfare-sensitive process control may impose local costs but generate broader social value through improved trust, reduced disease burden, and more robust governance (Papoula-Pereira et al., 2025).

Discussion

The apparent contradiction between slaughter and welfare cannot be fully eliminated, because slaughter culminates in the intentional killing of animals. What can be done, however, is to prevent that contradiction from being obscured by sentimental simplification on one side or technocratic denial on the other. The available evidence suggests that the most responsible approach is one that recognizes slaughter as ethically problematic, while still insisting on the strongest possible safeguards in animal handling, stunning policy, process control, inspection, and transparency (D'Amico et al., 2017; Farm Animal Welfare, 2003; García-Díez et al., 2023; Grandin & Regenstein, 1994; Health & Welfare, 2020; Iulietto et al., 2018; Pandey et al., 2024; Trevisani et al., 2024b; Troy & Kerry, 2010).

The available literature also suggests that current public controversies often collapse distinct questions into one another. The welfare effects of non-stun slaughter are not identical to the legal status of religious freedom. The commercial destination of rejected carcasses is not identical to the theological legitimacy of halal or kosher certification. Consumer information is not identical to anti-religious discrimination. These distinctions matter because poor policy often arises from conceptual confusion (Baldinelli et al., 2012; D'Amico et al., 2017; Novelli et al., 2016; Salamano & Cenci Goga, 2015; Velarde et al., 2014).

At the same time, the evidence does not support complacency. The Italian case study demonstrates that a substantial proportion of meat derived

from cattle slaughtered without stunning may enter the conventional market without specific labelling, particularly in the context of Jewish slaughter where rejected carcasses and hindquarters are routinely diverted (D'Amico et al., 2017). Reviews on slaughterhouse surveillance further show that abattoirs can and should generate data relevant to welfare, zoonoses, contamination, and antimicrobial resistance (Cenci-Goga et al., 2024; García-Díez et al., 2023; Janiszewski et al., 2025; Papoula-Pereira et al., 2025; Trevisani et al., 2024a). The combination of these findings implies that the problem is not lack of theoretical tools but lack of fully integrated governance.

An important EU work on “best practices at the time of killing” (Anonymous, 2017) shows that the technical possibilities for improving slaughter welfare are already well described in guidance documents and voluntary manuals, including detailed examples of standard operating procedures, monitoring plans and contingency actions for both stunning and non-stun slaughter. For bovine animals slaughtered without pre-slaughter stunning, these texts converge with the Borest recommendations in emphasising systematic monitoring of behavioural indicators of consciousness, clear thresholds for corrective action for poor cuts or impeded blood flow, and the immediate use of a back-up stun whenever loss of consciousness is delayed or uncertain (Cenci-Goga et al., 2010; Novelli et al., 2016; Rossi et al., 2013; Salamano & Cenci Goga, 2015). In this sense, the main challenge is not the absence of technical solutions but their uneven implementation across Member States and plants, which calls for stronger integration between risk-based meat safety assurance systems, animal-welfare-focused surveillance, and plant-specific standard operating procedure open to official veterinary verification (Anonymous, 2017). A similar conclusion emerges from recent FAO (Food and Agricultural Organization) analysis, which frames animal welfare as a key component of sustainable livestock and agrifood systems and argues that its benefits would be greater if it were more consistently incorporated at multiple levels of governance, rather than treated as a separate or secondary concern (Doyle et al., 2025).

This is why the concept of meat quality must be defended in a broad sense. This broader understanding is also consistent with the recent WOA (World Organization for Animal Health) vision that animal welfare should not be treated as an isolated

technical issue, but as a component of sustainable food systems with implications for animal health, human well-being, social acceptability, and the long-term legitimacy of animal production. In that perspective, the slaughterhouse is not only a point of control over hygiene and process efficiency, but also a place where the ethical, social, and sustainability dimensions of meat production become visible and therefore accountable (WOAH, 2024). A high-quality meat system is not one that produces technically acceptable carcasses alone. It is one that can explain and justify its own procedures, document its control of animal suffering and microbiological risk, and provide consumers with access to relevant information without promoting stigma or misinformation (D'Amico et al., 2017; Efsa Panel on Biological Hazards, 2013; European Food Safety Authority, 2026; Trevisani et al., 2024b). In this sense, science serves both business and citizenship: it improves process control while also making the chain more accountable to society (B. T. Cenci-Goga & Clementi, 2002).

Conclusions

The quality of meat today cannot be reduced to a purely physical or microbiological property. As WOA has recently emphasized, animal welfare is increasingly understood as a key component of sustainability rather than a marginal ethical add-on, because it interacts with public trust, worker safety, animal health, and the social acceptability of livestock production (WOAH, 2024). It is the result of a complex system in which animal welfare, process hygiene, official controls, epidemiological intelligence, traceability, and consumer information interact continuously (Cenci-Goga & Clementi, 2002; Doyle

et al., 2025; García-Díez et al., 2023; Trevisani et al., 2024b). The slaughterhouse is the most visible and analytically rich point in this system, because it concentrates the consequences of farm management, transport conditions, slaughter technique, inspection practice, and contamination control (Cenci-Goga et al., 2024; Efsa Panel on Biological Hazards, 2013; European Food Safety Authority, 2026; García-Díez et al., 2023; Guardone et al., 2020).

Ritual slaughter remains one of the most sensitive areas in which these issues converge. The Italian evidence confirms that meat from cattle slaughtered without stunning, especially carcasses rejected from kosher certification, may enter the conventional market without adequate information to consumers (D'Amico et al., 2017). This does not justify simplistic or discriminatory narratives, but it does justify renewed reflection on transparent communication, welfare-sensitive process design, and evidence-based governance (Cenci-Goga & Clementi, 2002; D'Amico et al., 2017).

Reconciling what appears irreconcilable therefore does not mean pretending that slaughter is ethically neutral. It means building a food system in which ethical discomfort is met not with denial, but with stricter welfare safeguards, better surveillance, more rigorous risk management, and clearer information. Only in that way can meat quality remain a scientifically grounded concept while also responding to the legitimate expectations of contemporary society (Anonymous, 2017; D'Amico et al., 2017; Doyle et al., 2025; European Food Safety Authority, 2026; García-Díez et al., 2023; Janiszewski et al., 2025; Papadopoulos, 2025; Papoula-Pereira et al., 2025; Trevisani et al., 2024a; Trevisani et al., 2024b; WOA, 2024).

References

- [1] **Anonymous (2016):** Report from the commission to the european parliament and the council on systems restraining bovine animals by inversion or any unnatural position. In C. final (Ed.).
- [2] **Anonymous (2017):** Preparation of best practices on the protection of animals at the time of killing (Vol. Final report, Publications Office, 2017): European Commission: Directorate-General for Health and Food Safety.
- [3] **Baldinelli, C., P. Sechi, V. Cambiotti, S. Parmegiani, B. T. Cenci Goga (2012):** Religious slaughter and animal welfare: Data from an online consultation. *Ital. J. Food Saf.*, 1(5), 27-32. doi: 10.4081/ijfs.2012.5.27
- [4] **Campagnolo, M., C. Pedernera-Romano & et al. (2024):** Comparative analysis of abattoir-based measures and on-farm indicators for assessing animal welfare in cattle. *Vet. Sci.*, 13(3), 361. doi: 10.3390/vetsci13030361
- [5] **Ceccarelli, M., E. Lepirini, P. Sechi, M. F. Iulietto, L. Grispoli, E. Goretti, B. T. Cenci-Goga (2018):** Analysis of the causes of the seizure

- and destruction of carcasses and organs in a slaughterhouse in central Italy in the 2010-2016 period. *Ital J Food Saf.*, 7(1), 6899. doi: 10.4081/ijfs.2018.6899
- [6] Cenci-Goga, B. T. (2020): Halal food in Italy The Halal Food Handbook (pp. 413-437).
 - [7] Cenci-Goga, B. T., F. Clementi (2002): Safety assurance of foods: Risk management depends on good science but it is not a scientific activity. *J. Agric. Environ. Ethics*, 15(3), 305-313. doi: 10.1023/A:1015757526008
 - [8] Cenci-Goga, B. T., A. G. Fermani, S. Barbera (2013): Meat quality and slaughtering techniques. *Ind. Aliment.*, 52(538), 18-24+28.
 - [9] Cenci-Goga, B. T., C. Mattiacci, G. De Angelis, P. Marini, A. Cuccurese, R. Rossi, B. Catanese (2010): Religious slaughter in Italy. Paper presented at the Veterinary Research Communications.
 - [10] Cenci-Goga, B. T., E. Tedeschini, E. Costanzi, M. Maranesi, M. Karama, S. El-Ashram, C. Saraiva, J. García-Díez, M. Zerani, E. M. Al-Olayan, L. Grispoldi (2024): Correlation between Aerosol Particulates, Carcass Dirtiness, and Hygiene Indicators of Bovine Carcasses in the Abattoir Environment: Results of a Study in Italy. *Microbiol. Res.*, 15(2), 598-613. doi:10.3390/microbiolres15020039
 - [11] D'Amico, P., N. Vitelli, B. Cenci Goga, D. Nucera, F. Pedonese, A. Guidi, A. Armani (2017): Meat from cattle slaughtered without stunning sold in the conventional market without appropriate labelling: A case study in Italy. *Meat Sci.*, 134, 1-6. <https://doi.org/10.1016/j.meatsci.2017.07.011>
 - [12] De Boer, J., H. Schösler, H. Aiking (2014): Meatless or less meat? Exploring meat reduction strategies. *Appetite*, 73, 133-140. doi: 10.1016/j.appet.2013.11.010
 - [13] De Jonge, J., H. van Trijp (2013): Meeting heterogeneity in consumer demand for animal welfare: A reflection on existing knowledge and implications for the meat sector. *J. Agric. Environ. Ethics.*, 26(3), 629-661. doi: 10.1007/s10806-012-9426-7
 - [14] Directorate-General Health and Food Safety (2015): Study on information to consumers on the stunning of animals. Brussels: European Commission.
 - [15] Doyle, R., A. Cripps, A. Marry, B. Wieland, B. Whay, B. Lindsay, C. Munoz Gallardo, F. Di Leonardo, H. Huang, J. Stark, L. Keeling, M. Sánchez Mainar, M. Merridale-Punter, R. Petre, S. Zafra (2025): Animal welfare for production and working animals: evidence and need for action. In F. Rome (Ed.). Rome, FAO.
 - [16] EFSA Panel on Biological Hazards. (2013): Scientific Opinion on the public health hazards to be covered by inspection of meat from bovine animals. *EFSA Journal*, 11(6), 3266. doi: 10.2903/j.efsa.2013.3266
 - [17] EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare) (2020): Scientific Opinion on the welfare of cattle at slaughter. *EFSA Journal*, 18(11):6275, 107 pp. <https://doi.org/10.2903/j.efsa.2020.6275>
 - [18] European Food Safety Authority (2026): Animal welfare at slaughter.
 - [19] Farm Animal Welfare (2003): Report on the Welfare of Farmed Animals at Slaughter or Killing, Part 1: Red Meat Animals. London: FAWC.
 - [20] Farouk, M. M., H. M. Al-Mazeedi, A.B. Sabow, A. E. D. Bekhit, K. D. Adeyemi, A. Q. Sazili, A. Ghani (2014): Halal and kosher slaughter methods and meat quality: A review. *Meat Science*, 98(3), 505-519. doi: 10.1016/j.meatsci.2014.05.021
 - [21] Font-i-Furnols, M., L. Guerrero (2014): Consumer preference, behavior and perception about meat and meat products: An overview. *Meat Sci.*, 98(3), 361-371. doi: 10.1016/j.meatsci.2014.06.025
 - [22] Fuseini, A., S. B. Wotton, P. J. , Hadley, P. J., T. G. Knowles (2016): The perception and acceptability of pre-slaughter and post-cut stunning for halal production: The views of UK Islamic scholars and halal consumers. *Meat Sci.*, 123, 143-150. doi: 10.1016/j.meatsci.2016.09.002
 - [23] Garcia-Diez, J., S. Saraiva, D. Moura, L. Grispoldi, B. T. Cenci-Goga, C. Saraiva (2023): The importance of the slaughterhouse in surveilling animal and public health: A systematic review. *Vet. Sci.*, 10(3), 167. doi: 10.3390/vetsci10030167
 - [24] García-Díez, J., S. Saraiva, D. Moura, L. Grispoldi, B. T. Cenci-Goga, C. Saraiva (2023): The Importance of the Slaughterhouse in Surveilling Animal and Public Health: A Systematic Review. *Vet. Sci.*, 10(2), 167. Retrieved from doi:10.3390/vetsci10020167
 - [25] Gori, E., T. F. M. Chang, L. Iseppi, B. C. Goga, M. F. Iulietto, P. Sechi, M. A. Lepellere (2017): The assessment of consumer sensitivity to animal welfare: An application of Rasch Model. *Riv. Studi sulla Sostenibilità*, 2017(1), 107-127. doi: 10.3280/RISS2017-001008
 - [26] Grandin, T. (2013): Making slaughterhouses more humane for cattle, pigs, and sheep. *Annu. Rev. Anim. Biosci.*, 1, 491-512. doi: 10.1146/annurev-animal-031412-103713
 - [27] Grandin, T., J. M. Regenstein (1994): Religious slaughter and animal welfare: A discussion for meat scientists. *Meat Focus Int.*, 3, 115-123.
 - [28] Grispoldi, L., M. Karama, C. Hadjicharalambous, F. de Stefani, G. Ventura, M. Ceccarelli, M. Revoltella, P. Sechi, C. Crotti, A. D'Innocenzo, G. Couto-Contreras, B. Cenci-Goga (2020): Bovine lymph nodes as a source of *Escherichia coli* contamination of the meat. *Int. J. Food Microbiol.*, 331, 108715. doi: <https://doi.org/10.1016/j.ijfoodmicro.2020.108715>
 - [29] Guardone, L., A. Vitali, F. Fratini, S. Pardini, B. T. Cenci Goga, D. Nucera, A. Armani (2020): A Retrospective Study after 10 Years (2010–2019) of Meat Inspection Activity in a Domestic Swine Abattoir in Tuscany: The Slaughterhouse as an Epidemiological Observatory. *Animals*, 10(10), 1907. Retrieved from doi:10.3390/ani10101907
 - [30] Iulietto, M. F., P. Sechi, C. M. Gaudenzi, L. Grispoldi, M. Ceccarelli, S. Barbera, B. T. Cenci-Goga (2018): Noise assessment in slaughterhouses by means of a smartphone app. *Ital. J. Food Saf.*, 7(2), 79-82. doi: 10.4081/ijfs.2018.7053
 - [31] Janiszewski, P., M. Misuraca, E. Costanzi, B. C. Goga (2025): Ensuring ethical production of beef: A comprehensive risk assessment of animal welfare during transportation and slaughter processes. *EFSA Journal*, 23(S1), e231116. doi: <https://doi.org/10.2903/j.efsa.2025.e231116>
 - [32] Lada, S., G. H. Tanakinjal, H. Amin (2009): Predicting intention to choose halal products using theory of reasoned action. *Int. J. Islamic Middle East. Finance Manag.*, 2(1), 66-76. doi: 10.1108/17538390910946276
 - [33] Lever, J., M. Miele (2012): The growth of halal meat markets in Europe: An exploration of the supply side theory of religion. *Journal of Rural Studies*, 28(4), 528-537. doi: 10.1016/j.jrurstud.2012.06.004
 - [34] Novelli, S., P. Sechi, S. Mattei, M. F. Iulietto, B. Cenci-Goga (2016): Report on religious slaughter practices in Italy. *Vet. Ital.*, 52(1), 5-11. doi: 10.12834/VetItt.189.920.1

- [35] Pandey, S., S. Kim, E. S., Kim, G. B. Keum, H. Doo, J. Kwak, S. Ryu, Y. Choi, J. Kang, H. Kim, Y. Chae, K. H. Seol, S. M. Kang, Y. Kim, P. N. Seong, I. S. Bae, S. H. Cho, S. Jung, H. B. Kim (2024): Exploring the multifaceted factors affecting pork meat quality. *J Anim Sci Technol*, 66(5), 863-875. doi: 10.5187/jast.2024.e56
- [36] Papadopoulos, I. (2025): Ritual slaughter and supranational jurisprudence. *QOpen*, 3(2), qoad025. doi: 10.1093/qopen/qoad025
- [37] Papoula-Pereira, R., O. Alveike, B. T. Cenci-Goga, L. Grispoldi, G. E. Nagel-Alne, J. V. Ros-Lis, L. F. Thomas (2025): Economic evidence for the control of Salmonella in animal-derived food systems: A scoping review. *Food Control*, 175, 111275. doi: <https://doi.org/10.1016/j.foodcont.2025.111275>
- [38] Poeta, A., E. Santella, G. Salamano, A. Cuccurese, P. Sechi, V. Cambiotti, B. T. Cenci-Goga (2013): Acceptability of electrical stunning and post-cut stunning among muslim communities: A possible dialogue. *Soci. Anim.*, 21(5), 443-458. doi: 10.1163/15685306-12341310
- [39] Qekwana, D. N., C. M. E. McCrindle, J. W. Oguttu, D. Grace, B. T. Cenci-Goga (2017): Assessment of Welfare Issues During Traditional Slaughter of Goats in Pretoria, South Africa. *J. Appl. Anim. Welfare Sci.*, 20(1), 34-41. doi: 10.1080/10888705.2016.1217486
- [40] Rossi, R., A. Cuccurese, R. Pezzato, P. Marini, B. T. Cenci-Goga, C. Mattiacci, A. Poeta, P. Santori, G. Salamano, G. De Angelis, P. Sechi (2013): Religious slaughter: Data from surveys and spot-check visits in Italy and animal welfare issues. *Soc. Anim.*, 21(5), 459-488. doi: 10.1163/15685306-12341311
- [41] Salamano, G., B. Cenci Goga (2015): Religious slaughtering, animal protection and freedom of religion. *Ind. Aliment.*, 53(554), 5-10.
- [42] Trevisani, M., A. Rosamilia, M. R. Micheli, E. Guidi, B. T. Cenci Goga (2024a): Perspectives in the implementation of risk-based meat safety assurance system (RB-MSAS) in broiler meat production. *Food Control*, 160, 110308. doi: 10.1016/j.foodcont.2024.110308
- [43] Trevisani, M., A. Rosamilia, M. R. Micheli, E. Guidi, B. T. Goga (2024b): Perspectives in the implementation of risk-based meat safety assurance system (RB-MSAS) in broiler meat production. *Food Control*, 160, 110308. doi: <https://doi.org/10.1016/j.foodcont.2024.110308>
- [44] Troy, D. J., J. P. Kerry (2010): Consumer perception and the role of science in the meat industry. *Meat Sci.*, 86(1), 214-226. doi: 10.1016/j.meatsci.2010.05.009
- [45] Velarde, A., P. Rodriguez, A. Dalmau, C. Fuentes, P. Llonch, K. V. von Holleben, M. H. Anil, J. B. Lambooij, H. Pleiter, T. Yesildere, B. T. Cenci-Goga (2014): Religious slaughter: Evaluation of current practices in selected countries. *Meat Sci.*, 96(1), 278-287. doi: 10.1016/j.meatsci.2013.07.013
- [46] Warner, R. D., C. K. McDonnell, A. E. D. Bekhit, J. Claus, R. Vaskoska, A. Sikes, F. Dunshea, M. Ha (2017): Systematic review of emerging and innovative technologies for meat tenderisation. *Meat Sci.*, 132, 72-89. doi: 10.1016/j.meatsci.2017.04.241
- [47] WOA (2024): Animal welfare: a vital asset for a more sustainable world. In p. Paris (Ed.). WOA.

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Kvaliteta mesa i sama ideja klanja: kako pomiriti ono što se čini nepomirljivim

Sažetak

Više od stoljeća nakon *Džungle* Uptona Sinclaira, klaonice i dalje zauzimaju teško simboličko mjesto u javnoj raspravi, iako su se tehnološki, sanitarni i regulatorni okviri koji upravljaju suvremenom proizvodnjom mesa duboko promijenili. Suvremene klaonice visoko su organizirana industrijska okruženja u kojima se dobrobit životinja, sigurnost hrane, osposobljavanje radnika i sljedivost rješavaju putem kodificiranih postupaka i službenih kontrola. Istodobno, klanje ostaje etički sporno jer se nalazi na sjecištu ljudske prehrane, dobrobiti životinja, vjerske slobode i autonomije potrošača. Ovaj rad razmatra kako se pojam kvalitete mesa proširio izvan fizikalno-kemijskih i higijenskih svojstava te uključio društvene, etičke i informacijske dimenzije, osobito u odnosu na metode klanja i očekivanja potrošača. Posebna se pažnja posvećuje ritualnom klanju u Europi i Italiji, gdje klanje bez prethodnog omamljivanja i dalje ostaje pravno moguće na temelju posebnih izuzeća za vjerske obrede, dok istodobno i dalje postoji zabrinutost javnosti glede posljedica za dobrobit životinja i prodaje mesa takvih životinja na konvencionalnom tržištu. Podaci iz klaonica također se razmatraju kao epidemiološki i dobrobitni opservatorij, sposoban pružiti informacije o lezijama na trupovima, proglašenjima neupotrebljivosti, putovima kontaminacije, antimikrobnoj rezistenciji i zoonotskim rizicima koji su relevantni i za veterinarsko javno zdravstvo i za upravlja-

nje poslovanjem u prehrambenom sektoru. Rad tvrdi da pomirenje prividne proturječnosti između klanja i dobrobiti ne zahtijeva retoričko pojednostavljivanje, nego rigorozan okvir utemeljen na dokazima, u kojem pokazatelji dobrobiti, higijena procesa, sljedivost i transparentne informacije koegzistiraju s kulturnim i vjerskim pluralizmom.

Keywords: Kvaliteta mesa; klaonica; dobrobit životinja; ritualno klanje; označavanje; pregled mesa; sigurnost hrane; sljedivost

Die Qualität von Fleisch und die Idee der Schlachtung: wie lässt sich das scheinbar Unvereinbare in Einklang bringen?

Zusammenfassung

Mehr als ein Jahrhundert nach Upton Sinclairs „Der Dschungel“ nehmen Schlachthöfe in der öffentlichen Debatte weiterhin eine schwierige symbolische Stellung ein, obwohl sich die technologischen, hygienischen und regulatorischen Rahmenbedingungen der modernen Fleischproduktion grundlegend verändert haben. Moderne Schlachthöfe sind hochgradig organisierte industrielle Umgebungen, in denen Tierschutz, Lebensmittelsicherheit, Schulung des Personals und Rückverfolgbarkeit durch festgelegte Verfahren und behördliche Kontrollen gewährleistet werden. Gleichzeitig bleibt das Schlachten ethisch umstritten, da es an der Schnittstelle zwischen menschlicher Ernährung, Tierschutz, Religionsfreiheit und Verbraucherautonomie liegt. Dieser Beitrag erörtert, wie sich das Konzept der Fleischqualität über physikalisch-chemische und hygienische Eigenschaften hinaus auf soziale, ethische und informative Dimensionen ausgeweitet hat, insbesondere in Bezug auf Schlachtmethoden und Verbrauchererwartungen. Besondere Aufmerksamkeit gilt der rituellen Schlachtung in Europa und Italien, wo die Schlachtung ohne vorherige Betäubung im Rahmen spezifischer Ausnahmeregelungen für religiöse Riten weiterhin gesetzlich zulässig ist, während in der Öffentlichkeit weiterhin Bedenken hinsichtlich der Auswirkungen auf das Tierwohl und der Vermarktung von Fleisch dieser Tiere auf dem konventionellen Markt bestehen. Daten aus Schlachthöfen werden zudem als epidemiologisches und tierschutzbezogenes Beobachtungssystem betrachtet, das Informationen zu Schlachtkörperläsionen, Ausschuss, Kontaminationswegen, Antibiotikaresistenzen und zoonotischen Risiken liefern kann, die sowohl für die veterinärmedizinische öffentliche Gesundheit als auch für das Management von Lebensmittelunternehmen relevant sind. Der Beitrag argumentiert, dass die Überwindung des offensichtlichen Widerspruchs zwischen Schlachtung und Tierschutz keine rhetorische Vereinfachung erfordert, sondern einen strengen, evidenzbasierten Rahmen, in dem Tierschutzindikatoren, Prozesshygiene, Rückverfolgbarkeit und transparente Informationen mit kulturellem und religiösem Pluralismus koexistieren.

Schlüsselwörter: Fleischqualität; Schlachthof; Tierschutz; rituelle Schlachtung; Kennzeichnung; Fleischkontrolle; Lebensmittelsicherheit; Rückverfolgbarkeit

Calidad de la carne y el concepto del sacrificio: cómo reconciliar lo que parece irreconciliable

Resumen

Más de un siglo después de La jungla de Upton Sinclair, los mataderos siguen ocupando un lugar de fuerte carga simbólica en el debate público, aunque los marcos tecnológicos, sanitarios y regulatorios que rigen la producción moderna de carne han cambiado profundamente. Los mataderos modernos constituyen entornos industriales altamente organizados en los que el bienestar animal, la inocuidad alimentaria, la capacitación del personal y la trazabilidad se gestionan mediante procedimientos estandarizados y controles oficiales. Al mismo tiempo, el sacrificio continúa siendo una cuestión éticamente

controvertida, ya que se sitúa en la intersección entre la alimentación humana, el bienestar animal, la libertad religiosa y la autonomía del consumidor. Este trabajo analiza cómo el concepto de calidad de la carne ha evolucionado más allá de las propiedades fisicoquímicas e higiénico-sanitarias para incorporar dimensiones sociales, éticas e informativas, especialmente en relación con los métodos de sacrificio y las expectativas de los consumidores. Se presta especial atención al sacrificio ritual en Europa e Italia, donde el sacrificio sin aturdimiento previo sigue siendo legal en virtud de exenciones específicas para los ritos religiosos, mientras persiste la preocupación pública por sus implicaciones para el bienestar animal y por la comercialización de la carne procedente de estos animales en los canales convencionales de mercado. Asimismo, los datos generados en los mataderos se consideran un observatorio epidemiológico y de bienestar animal, capaz de aportar información sobre lesiones de las canales, decomisos, vías de contaminación, resistencia a los antimicrobianos y riesgos zoonóticos, aspectos de gran relevancia tanto para la salud pública veterinaria como para la gestión de las empresas del sector alimentario. El trabajo sostiene que reconciliar la aparente contradicción entre el sacrificio y el bienestar animal no requiere simplificaciones retóricas, sino un marco riguroso basado en la evidencia, en el que los indicadores de bienestar, la higiene de los procesos, la trazabilidad y la información transparente coexistan con el pluralismo cultural y religioso.

Palabras claves: calidad de la carne, matadero, bienestar animal, sacrificio ritual etiquetado, inspección de la carne, inocuidad alimentaria, trazabilidad

Qualità della carne e il concetto stesso di macellazione: come conciliare ciò che sembra inconciliabile

Riassunto

A oltre un secolo da La giungla di Upton Sinclair, i macelli continuano a occupare una posizione simbolica complessa nel dibattito pubblico, sebbene i quadri tecnologici, sanitari e normativi che disciplinano la moderna produzione della carne siano profondamente mutati. I macelli contemporanei sono ambienti industriali altamente organizzati, nei quali il benessere animale, la sicurezza alimentare, la formazione del personale e la tracciabilità sono garantiti mediante procedure codificate e controlli ufficiali. Al tempo stesso, la macellazione continua a essere oggetto di controversie etiche, poiché si colloca all'intersezione tra alimentazione umana, benessere animale, libertà religiosa e autonomia del consumatore. Il presente lavoro riflette su come il concetto di qualità della carne si sia esteso oltre gli aspetti fisico-chimici e igienico-sanitari, includendo anche dimensioni sociali, etiche e informative, in particolare in relazione ai metodi di macellazione e alle aspettative dei consumatori. Particolare attenzione è dedicata alla macellazione rituale in Europa e in Italia, dove la macellazione senza preventivo stordimento rimane giuridicamente consentita sulla base di specifiche deroghe previste per i riti religiosi, mentre permane la preoccupazione dell'opinione pubblica riguardo alle conseguenze per il benessere animale e all'immissione sul mercato di carni provenienti da tali animali nel circuito commerciale convenzionale. I dati provenienti dai macelli vengono inoltre considerati quali strumenti di osservazione epidemiologica e del benessere animale, in grado di fornire informazioni sulle lesioni delle carcasse, sulle dichiarazioni di non idoneità al consumo, sulle vie di contaminazione, sulla resistenza agli antimicrobici e sui rischi zoonotici, rilevanti sia per la sanità pubblica veterinaria sia per la gestione aziendale nel settore alimentare. Il lavoro sostiene che la conciliazione dell'apparente contraddizione tra macellazione e benessere animale non richiede semplificazioni retoriche, bensì un rigoroso quadro fondato sulle evidenze scientifiche, nel quale gli indicatori di benessere, l'igiene del processo, la tracciabilità e un'informazione trasparente coesistano con il pluralismo culturale e religioso.

Parole chiave: Qualità della carne; macello; benessere animale; macellazione rituale; etichettatura; ispezione delle carni; sicurezza alimentare; tracciabilità.